INDIAN TEA ASSOCIATION

SCIENTIFIC DEPARTMENT

ANNUAL REPORT—1941

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The work at Tocklai as far as possible has been carried on in accordance with the published programme but the loss of six Officers has necessarily resulted in restriction. This will be appreciated when it is remembered that every Officer is a specialist, and it is impossible to hand over entirely his work to another. In some cases it is possible to continue to make progress but at a slow rate and in other cases it is only possible to continue collecting data which will be available for the Officer when he returns.

The Officers at present on national service are—

Mr. L. C. Comrie	...	*Entomologist*
,, R. J. Gilchrist	...	*Tea Taster*
Dr. E. A. H. Roberts	...	*Chemist*
,, W. Wight	...	*Botanist*
Mr. E. J. Winter	...	*Advisory Officer, Surma Valley*
Dr. E. K. Woodford	...	*Advisory Officer, Darjeeling.*

Touring

The routine touring of gardens is the duty of the recently appointed Advisory Officers but owing to two being on service and one, Mr. Mitchell, being sick, this touring has been entirely suspended in the Surma Valley and Darjeeling districts, and has been very limited in the Dooars.

An endeavour has however been made to arrange for an Officer from Tocklai to visit estates carrying out field experiments in co-operation with us. Where possible such visits

have been extended to the neighbouring gardens who wish to have consultation with a Scientific Officer. Whilst then visits have been paid to a number of estates yet it is fully realised that the touring which is so necessary to maintain the liason between the Scientific Department and commercial interests has been far from sufficient but shortage of staff precludes any possibility of increase.

We are deeply appreciative of the efforts Managers are making to continue the field experiments with the necessary degree of accuracy. There are more than 80 experiments throughout the tea districts of North-East India designed to ascertain the values of compost, cattle and mineral manures, and also to ascertain the relative value of nitrogen phosphoric acid and potash, and also the value of shade trees.

Manuring

With the rising tea export quota, gardens will have to produce increasing quantities of tea and this brings the problem of adequately feeding the tea bush prominently to notice. The cost of manures is rising and they are becoming more and more difficult to obtain. It is necessary therefore to give consideration to the means whereby the bush can be maintained at the desired cropping level. Experiments carried out throughout North-East India has shown the outstanding value of nitrogen and the small and generally non-economic value of phosphoric acid and potash. It is fortunate that data of a reliable nature is now to hand and that we need, at any rate for the time being, consider only the supply of nitrogen. This can be given in the form of manures but which in all probability will be at an increasing cost as time goes on.

General experience and carefully designed field experiments have shewn that the growing of leguminous plants can replace at any rate to some extent the use of nitrogenous manure.

Experiments also have shown that the value of all leguminous plants is not the same, for instance Cowpeas grown for two successive seasons at Tocklai gave no increase in crop over an area receiving no treatment whereas Boga Medeloa grown for the same period gave a total increase of tea crop of 8.3 mds. per acre over a period of seven years.

Sulphate of ammonia applied in two successive years at the rate of 150 lbs. per acre, giving 30 lbs. nitrogen per acre per application gave a total increase of 4.8 mds. per acre over seven years.

The results obtained from an experiment utilising Sau trees (*Albizzia stipulata*) in which these trees and the tea were planted out together at the same age (1936-37) that is one year old from seed, show that the trees at first restricted the growth of the tea but in the sixth year they are having a marked beneficial effect. The crops from the plots shaded but not otherwise manured have given an increase over the unshaded and unmanured plots of 2.14 mds. per acre, *i.e.*, 7.89 as against 5.75.

The experiment has also shown that the response to added manure is not the same on shaded and unshaded areas. It is less on the areas shaded and it is for this reason that it is suggested in order to economise expenditure, that where possible areas not shaded shall be manured and that shaded areas shall not be manured. This is a general suggestion and must be accepted as a guide and not as a recommendation. The treatments given must be adjusted to the crop required from an area.

The first beneficial effect from the Sau trees is noticed in the third year, and whilst they may be properly considered as long term manuring yet the first returns are obtained after a comparatively short while. It is also to be remembered that whilst the cost of manures is increasing the cost of growing

green crops or shade trees has increased but little and that once the trees are growing they have a permanent manuring effect lasting over a period of perhaps 20 years whereas the application of manures can be stopped at any moment according to the dictates of finance.

Tea Selection

During the year much work has been done with the examination of individual tea bushes in respect to the characters of the finished teas. A notable example was the examination of 72 bushes in the 1919 Betjan Plots. The teas made showed a great range in characters and in valuation which varied from As. 14-9 for the poorest tea to Rs. 1-12 for the best tea. In considering this result it needs to be remembered that this jat is one having good quality and notable for evenness in leaf appearance. The difference in the characteristics and in the valuations of the tea manufactured throughout the season of individual bushes can then be considered as astounding and gives some indication of the improvement that may be expected to result from scientific selection.

Whilst we are willing to help those desirous of undertaking selection work yet it must be clearly understood that this is to be regarded as still of an experimental nature for it is not possible to make definite statements about it until the cuttings taken from the selected bushes have been planted in numbers and grown to a full cropping condition so that the tea made can be critically examined on a commercial basis.

Vegetative Propagation

Much work has been done and is still in progress to ascertain the various factors that effect the successful formation of rooted cuttings and it is too early to make any detailed report but a few facts of interest have emerged.

The cuttings planted die in patches which is often not correlated with the particular treatment given. This is

thought to be due to fungal or bacterial activity in the soil. Experiments have shewn that :—

(1) The admixture of cattle manure with the soil before planting the cuttings is detrimental and it is thought that the use of soil from "Hullahs" also has a similar detrimental effect.

(2) Watering the cuttings with cattle manure water once a week for one month after planting has a detrimental effect.

Owing to the uncontrolled errors that arise with cutting experiments using soil, experiment with water cultures have been commenced. It has been found so far that immersing the bottom cut in water has given as good results as any other treatment. The use of an extract of cattle manure added to the water has proved detrimental.

It is noticeable that the root system of the cuttings differs from that of seedlings in that the cuttings develop several thickish roots which spread in a more or less lateral direction rather than as a definite tap root which is characteristic of seedlings, but this may be modified for in an experiment using a subsoil of sand the survival cuttings had longer thicker roots compared with those grown under ordinary soil conditions.

The behaviour of the cuttings when planted out has been sufficiently successful to allow us to adopt this method for infilling rather than using seedlings. We have given preference to cuttings as they allow of the infilling being raised from bushes already grown in the plots and thus it is possible to maintain the character of the plot better than by using seed collected from bushes growing away from Tocklai.

Whilst then time and energy have been devoted towards the vegetative propagation of bushes yet it must be borne in

mind that this method can only result in making the best use of the bushes that are now available. Only breeding work can result in obtaining better varieties than exist at the present day and this work is not being neglected. It is the main work of the Botanical Branch but it will be many years before it can have practical application.

Pruning Tea Seed Bushes

Experiments with the pruning of tea seed bushes have shewn that under the conditions of the experiment the unpruned shoots bore the greater number of fruits but that the pruned shoots retained a significantly greater number of fruits per hundred flowers. The results of this experiment shew that correct summer pruning some time before bushes come into bloom is a promising method of increasing the percentage of flower to set fruit. The pruning has effected the percentage of fruit retained but it is not possible to determine from this preliminary experiment the optimum pruning treatment.

Pests

During the year the stinging nettle grub has developed to the extent of being a pest on several gardens and if the attack is allowed to go unchecked it may become serious. The collection of chrysalids in the soil during the cold weather is advocated. Moths will begin to emerge in March. On a garden nearby to Tocklai many of the caterpillars were found to be parasitised by an ichneumon fly with the result that many of the caterpillars died. Such biological control, where it becomes effective, is probably the best means of combating any insect pest. Consequently the destruction of the parasite should be avoided as far as possible and if the stinging nettle grubs are being hand collected then those that are obviously in an unhealthy and dying condition should be allowed to remain so that the parasite may develop. They should not be collected and burnt.

This instance is given because there is a tendency for the annual systematic collection of chrysalids during the cold

weather to be allowed to lapse which results in an outbreak such as that I have mentioned.

Branch Canker

The term branch canker has been used to describe many diseases and mechanical effects which cause the bark on the main stems of bushes to die and which often remains unnoticed until the swelling cambium layer causes a crack which develops into a canker. Such are caused generally in North-East India by sun scorch. They are more alarming than serious for bushes shewing severe sun scorch after medium pruning have in course of time lost any evidence of damage. The experiment carried out at Tocklai deals entirely with sun scorch damage and takes no account of damage caused by *Macrophoma* or allied disease.

This experiment had for its object to find out whether shading the bushes would reduce or eliminate the damage.

The treatments and results obtained are—

The Treatment	Reduction in incidence of sunscorch
1. Fitting thatched shade over the bushes so that no sun could reach the branches (Shades removed 22-10-40)	68%
2. White-washing all branches exposed to the South and Western sun ...	65%
3. Placing all the branches which have been cut off in the medium prune, back on the top of the bush (Branch removed again 22-10-40) ...	30%
4. Treatments 1, 2 and 3 combined ...	80%

Two of these treatments Nos. 2 and 3 are capable of practical application.

An important fact emerges from the experiment and that is that the higher yielding bushes are more liable to sun scorch damage than the poorer yielding.

Another experiment in which half the bushes medium pruned to 20" from the ground in September were shaded by Boga Medeloa and the other half left with no shade. When examined in November evidence of severe sun scorch was found on the unshaded bushes whereas little or no sun scorch could be seen on the shaded bushes.

Another experiment conducted on a tea estate clearly shewed the effect of time of pruning upon sun scorch incidence—

Pruning time	Total bushes per plot	Number of bushes shewing sunscorch
September ...	540	228
October ...	540	247
November ...	540	28
December ...	540	42
January ...	540	27

The damage in September—October is significantly greater than in November—December—January.

Black Rot and Thread Blight

Field experiments are in progress; the results have yet to be collated.

Subsidiary Crops

Tung—At Tocklai there are several small areas planted with *Aleurites Montana*. On one small collection of trees now over eight years old two of the bushes have given over 50 lbs. of nuts per tree. Another collection of trees 0.8 acres now in the fourth year from planting gave 3 mds. of nuts which sold at the rate of Rs. 25 per md. The bud grafting of Tung can be comparatively easily and successfully carried out but so far we have been unable to raise any cutting.

Derris Eliptica—This plant which is the source of the insecticide Rotenone grows well on the poor sandy soil of Tocklai. It remains to ascertain whether the Rotenone content

is sufficient for economic purposes when grown under Assam conditions. It is not suggested that this crop should be grown as a cash crop but that it may be grown for use on gardens as an insecticide thus saving buying expensive insecticides.

Other Crops—Napier, Guinea Grass, Soya Bean and Groundnuts have all been grown successfully at Tocklai, but Tobacco has not proved the success hoped for.

Acetone

The Indian Tea Association Committee expressed themselves willing to allow their Scientific Department to help in investigations that were necessary for war purposes.

Sir S. S. Bhatnagar, Director of the Board of Scientific and Industrial Research, asked us to investigate the production of acetone by fermentation. Dr. Woodford who had been called up for military service was released for this work and returned to Tocklai. He was engaged in this investigation for three months and was able to produce a pure culture of an organism which by the fermentation of molasses gave an acetone outturn equal to that given in any published results that we have been able to find. At the end of the three months the investigation had reached a stage when it should be transferred to a pilot plant. Dr. Woodford gave a very interesting and useful report. The necessity for us to continue work then ceased. Dr. Woodford was recalled to military service and is now serving in the Indian Army Ordnance Corps where I hope his scientific knowledge will be fully and properly utilised.

I wish to take this opportunity to express my thanks to Prof. L. A. Underkofler of the Iowa State College, U.S.A., who has devoted a great deal of study to the production of acetone by fermentation. We wrote to him asking if he would be good enough to send us a culture of the organism that he had found to give satisfactory results. He replied by sending us a pure culture by air mail free of all costs.

Vegetable Extract

It has also been possible to develop a method for the production of a vegetable extract which contains valuable vitamins. Such a product is required in considerable quantities by the military authorities at the present time and in peace time such a preparation is likely to meet with a very considerable demand. I hope its production in India on a commercial scale may be developed soon.

Water

The sterilization of water for drinking purposes has continued to receive the attention of the Bacteriologist.

Buildings

The buildings at Tocklai have been maintained in a satisfactory state. I am glad to be able to report that your offer to allow the wives of tea planters to occupy the empty bungalows by reason of Mr. Comrie and Dr. Roberts being on military service, has been accepted by Mrs. Hambleton.

Whilst the enemy activity over Jorhat district may be considered as very unlikely yet I have felt it better to be prepared to some extent for the unlikely event and half-filled sandbags and tins of sand together with scoops have been arranged in accessible places at all the buildings for dealing with outbreaks of fire.

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